

REMARKS

1. CLAIM AMENDMENTS

The Office Action states that original claims 1, 2, and 4–10 have been re-numbered as claims 1–9.

Claims 1–9 were pending in the application. Claims 1, 2, 4, 6, and 9 have been amended to clarify the invention. Claim 10 has been added. Support for the claim amendments and new claim 10 is found in the originally filed specification. No new matter has been added. Upon entry of the present amendment, claims 1–10 will be pending.

2. THE REJECTION OF CLAIM 2 UNDER U.S.C. § 112, SECOND PARAGRAPH SHOULD BE WITHDRAWN

Claim 2 is rejected under 35 U.S.C. § 112, second paragraph, as allegedly indefinite for failing to particularly point out and distinctly claim the subject matter which Applicants regard as the invention.

Claims 2 and 3 were inadvertently merged into a single paragraph in the originally filed application. As can be surmised from the description in the originally filed specification, original claim 2 ends at “electronegativity of 1.8~2.3,” while originally-intended claim 3 begins at “3. The facilitated transport membrane. . .” As shown in Table 1 on page 9 of the specification, the electronegativity is given as a two-digit decimal value for the various transition metals. For example, paragraph [0029] of the specification discloses that a transition metal with an electronegativity of 2.3 is applicable in the invention.

Therefore, Applicants have amended claim 2 to delete the subject matter belonging to originally-intended claim 3. Applicants have also added new claim 10, which includes the subject matter of originally-intended claim 3. Applicants believe that amended claim 2 obviates the rejection, and request that the rejection of claim 2 under 35 U.S.C. § 112, second paragraph, be withdrawn.

3. THE CLAIMS ARE NOT ANTICIPATED BY THE CITED REFERENCES

Claims 1–5, and 7–9 are rejected under 35 U.S.C. § 102(b) as allegedly being anticipated by United States Patent No. 5,062,866 to Ho (“Ho”). Claims 1, 2, 5, and 6 are rejected under 35 U.S.C. § 102(b) as allegedly being anticipated by United States Patent No. 3,773,844 to Perry (“Perry”). Claims 1–5, and 7–9 are rejected under 35 U.S.C. § 102(e) as allegedly being anticipated by United States Patent No. 6,645,276 to Kang *et al.* (“Kang 1”).

Claims 1–5, and 7–9 are rejected under 35 U.S.C. § 102(b) as allegedly being anticipated by United States Patent No. 6,468,331 to Kang *et al.* (“Kang 2”). Applicants respectfully traverse this rejection.

Applicants have amended claim 1 to clarify that Applicants’ facilitated transport membrane for separating alkene hydrocarbons from hydrocarbon mixtures is operated under dry operating conditions. Applicants’ facilitated transport membrane comprises a porous supported membrane and a transition metal salt-polymer membrane. The transition metal salt-polymer membrane includes a transition metal salt and a polymer having double carbon bonds.

Applicants’ Facilitated Transport Membrane is not Anticipated by Ho

Applicants’ facilitated transport membrane is not anticipated by Ho, because Ho does not teach, whether expressly or inherently, Applicants’ facilitated transport membrane comprising a polymer having double carbon bonds and operated under dry operating conditions. Rather, Ho teaches a membrane prepared from a hydrophilic polymer, such as polyvinylalcohol, polyvinylacetate and polyvinylpyrrolidone. *See Ho, e.g., col. 5, lines 6–21 and 31–40.* Furthermore, Ho further teaches a membrane prepared from a hydrophilic polymer, a transition metal salt, and a hydrophilic salt of a Group I metal. *See Ho, e.g., col. 5, lines 22–30.* As Ho teaches, membranes prepared from such hydrophilic polymers are prepared for stability in wet operating conditions. *See Ho, e.g., col. 5, lines 6–30; col. 7, lines 33–44; and col. 9, lines 4–8.* By contrast, Applicants have discovered that a membrane consisting essentially of a polymer having double carbon bonds and a transition metal salt exhibits superior long-term operational performance characteristics over the types of membranes disclosed in Ho. As Applicants have pointed out, membranes prepared from such hydrophilic polymers, *e.g.*, polymers containing functional groups including oxygen and/or nitrogen, exhibit performance deterioration. *See specification, e.g., paragraph [0019].* Applicants’ facilitated transport membrane provides a solution to the problems associated with the hydrophilic polymers disclosed in Ho, such as the reduction of the transition metal ion to the transition metal. *See specification, e.g., paragraphs [0019] and [0069].* Therefore, Applicants’ facilitated transport membrane is not anticipated by Ho, because Ho does not teach, whether expressly or inherently, Applicants’ facilitated transport membrane comprising a polymer having double carbon bonds and operated under dry operating conditions.

In view of the foregoing, the rejections of claims 1–5, and 7–9 under 35

U.S.C. § 102(b) as anticipated by Ho should be withdrawn. Applicants also submit that new claim 10 is also not anticipated by Ho for at least the same reasons that claims 1 and 2 are not anticipate by Ho.

Applicants' Facilitated Transport Membrane is not Anticipated by Perry

Applicants' facilitated transport membrane is not anticipated by Perry, because Perry does not teach, whether expressly or inherently, each and every limitation of Applicants' claims. Perry teaches a membrane for separating an alkene from organic mixtures containing the same using a pervaporation technique. *See Perry, e.g., col. 1, lines 13–24.* The pervaporation process is generally performed under wet operating conditions. As applicants have pointed out, techniques that require the feed of a liquid solvent (*e.g.*, water), present many problems. *See specification, e.g., paragraphs [0009] through [0014].* For example, the liquid solvent has to be removed from the separated product. *See specification, e.g., paragraph [0014].* By contrast, Applicants' facilitated transport membranes overcome the limitation inherent in Perry, as Applicants' facilitated transport membranes are operated under dry operating conditions. Therefore, Applicants' claims are not anticipated by Perry, because Perry does not teach, whether expressly or inherently, each and every limitation of the claims.

In view of the foregoing, the rejections of claims 1, 2, 5, and 6 under 35 U.S.C. § 102(b) as anticipated by Perry should be withdrawn. Applicants also submit that new claim 10 is also not anticipated by Perry for at least the same reasons that claims 1 and 2 are not anticipate by Perry.

Applicants' Facilitated Transport Membrane is not Anticipated by Kang 1 or Kang 2

Applicants' facilitated transport membrane is also not anticipated by either Kang 1 or Kang 2 for at least the same reasons that Applicants' claimed invention is not anticipated by Ho. Similar to Ho, Kang 1 and Kang 2 teach preparing membranes from hydrophilic polymers. For example, Kang 1 teaches that suitable polymers for preparing the membrane include polymers with large dielectric constants, such as polyvinylalcohol, polyvinylacetate, and polyvinylpyrrolidone. *See Kang 1, e.g., col. 6, lines 46–60.* It should be noted that all of these polymers are specifically named in Ho as suitable hydrophilic polymers for use in preparing membranes. *See Ho, e.g., col. 5, lines 31–40.* Therefore, the requirement in Kang 1 of polymers with large dielectric constants is cumulative to Ho's requirement of a hydrophilic polymer. Kang 2 teaches that suitable polymers for preparing

the membrane contain a nitrogen atom or amide group, including polyvinylpyrrolidone and polyacrylamide. *See* Kang 2, *e.g.*, col. 4, lines 4–11. Both of these polymers are specifically named in Ho as suitable hydrophilic polymers for use in preparing membranes. *See* Ho, *e.g.*, col. 5, lines 31–40. Kang 2 also teaches preparing a membrane using poly(2-ethyl-2-oxazole) (POZ) and poly(ethyleneimine), which are both hydrophilic polymers with large dielectric constants. *See* Kang 2, *e.g.*, col. 4, lines 4–11 and Kang 1, *e.g.*, col. 6, lines 46–60. Therefore, the teaching in Kang 2 is also cumulative to the teaching in Ho.

As Applicants have disclosed, Applicants' membrane comprising a polymer having double carbon bonds does not exhibit the deterioration in performance observed in the type of membranes disclosed in Kang 1 and Kang 2 prepared from hydrophilic polymers. *See* specification, *e.g.*, paragraph [0019]. In particular, membranes comprising hydrophilic polymers having oxygen and/or nitrogen functional groups exhibit a reduction of the transition metal ion to the transition metal, which can degrade the performance. *See* specification, *e.g.*, paragraphs [0019] and [0069]. By contrast, the membrane of the present invention exhibit superior long-term operational performance characteristics over membrane comprising such polymer having a functional group including oxygen and/or nitrogen. As Applicants have shown in Table 10 on page 20 of the specification, the permeability and selectivity of a hydrophilic polymer/transition metal salt membrane (*i.e.*, POZ/AgBF₄ membrane) continuously decreased with time. By contrast, the performance of a polyhexamethylene vinylene/transition metal salt membrane (*i.e.*, PHMV/AgBF₄ membrane) remained basically stable under long-term operation of nearly 150 hrs. Therefore, Applicants' claimed invention is not anticipated by either Kang 1 or Kang 2 for at least the same reasons that Applicants' claimed invention is not anticipated by Ho.

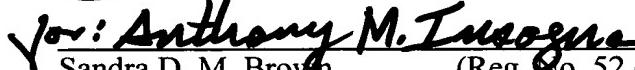
In view of the foregoing, the rejection of claims 1–5, and 7–9 under 35 U.S.C. § 102(e) as anticipated by Kang 1 should be withdrawn. Similarly, the rejection of claims 1–5, and 7–9 under 35 U.S.C. § 102(b) as anticipated by Kang 2 should be withdrawn. Furthermore, Applicants submit that new claim 10 is also not anticipated by Kang 1 or Kang 2 for at least the same reasons that claims 1 and 2 are not anticipate by Kang 1 or Kang 2.

CONCLUSION

Applicants respectfully request that the foregoing amendments and remarks be made of record in the file of the above-identified application. Applicants believe that each ground for rejection has been successfully overcome or obviated, and that all pending claims are in condition for allowance. Withdrawal of the Examiner's rejections, and allowance of the application, are respectfully requested. If any issues remain in connection herewith, the Examiner is respectfully invited to telephone the undersigned to discuss the same.

No fee is believed due in connection with this response. In the event that a fee is required, please charge any such fees to Jones Day Deposit Account No. 50-3013.

Respectfully submitted,



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